

SECTION 85

INSTRUMENTS AND MISCELLANEOUS GAGE BOARDS

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13	85.1 REFERENCES	
14	(85A) Code of Federal Regulations - 46 CFR Sub-chapter F	
15	85.2 INTRODUCTION	
16	This Section contains the Contractor Design and Provide general requirements for local	
17	instrumentation and gage boards and is supplemented by the requirements described in other	
18	Sections of the Technical Specification.	
19	<i>For WSF Fleet-wide Standardization purposes, End No. 1 of the Vessel shall always be</i>	
20	<i>considered the bow, and this designation shall delineate port and starboard, fore and aft</i>	
21	<i>wherever they are addressed in the Technical Specification.</i>	
22	85.3 GENERAL	
23	The Contractor shall provide and/or install all instrumentation and gage boards generally as	
24	specified and/or required herein. The Contractor shall provide instrumentation implementing	

1 manufacturer commonality to the greatest extent possible (e.g. All pressure gages shall be of
2 the same Manufacturer and Series).

3 Mechanical instruments and their components shall be of rugged construction, specifically
4 designed for the marine environment and made of corrosion-resistant materials. Instrument
5 accuracy from source to readout shall be within plus or minus 1-percent ($\pm 1\%$) of full scale
6 reading.

7 The Contractor shall provide local and remote instrumentation, including tubing, piping,
8 fittings, valves, wiring and power sources, switches, panels, gage boards, foundations,
9 brackets, hangers and other similar items and devices as are required to ensure that the
10 instrumentation performs its intended function.

11 Sufficient instrumentation shall be provided so that all information vital to the proper
12 operation and maintenance of equipment and components are displayed and that emergency
13 and alarm conditions are brought to the attention of the Vessel operators.

14 For each remote reading instrument installed, except Main Engine exhaust pyrometers,
15 provide a local reading instrument.

16 Instrumentation piping system components and materials shall be designed and installed in
17 accordance with ASTM F721, this Section and Sections 12, 74, 95 and 99 of the Technical
18 Specification. All instrumentation sensing lines shall be provided with root valves at the
19 system connection.

20 **NOTE:** The outside diameter of takeoff connections may not be less than 0.840 inches
21 for service conditions up to 900 psig or 800F degrees, and 1.050 inches for
22 conditions that exceed either of these limits, as set forth in 46 CFR §56.50-97.

23 All tubing to gages, pressure switches and the like, shall include two (2), 4-inch diameter
24 tubing loops just upstream of that instruments gage valve wherever instrument tubing is
25 attached to rotating machinery so as to minimize tubing metal fatigue due to vibration.

26 All gages and indicators shall be readable from normally accessible locations. Provide
27 supplementary illumination if available area lighting is not sufficient.

28 Do not run capillary tubes, gage tubing, or piping over electrical equipment unless they are
29 shielded from leakage. As a WSF Standardized practice, certain system gauges that have in
30 the past caused liquid, air, or dirt contamination inside an EOS Control Console are located
31 in a remote, dedicated gage board to prevent the risk of such contamination. This gage board
32 shall be located to be readily viewable from the console, as approved by the WSF
33 Representative. See the *GAGE BOARDS* Subsection in this Section of the Technical
34 Specification

35 Provide a label plate for each instrument showing the purpose for which it is intended. Label
36 plates shall be in accordance with Section 24 of the Technical Specification.

For cable installation identification and termination, see Section 87 of the Technical Specification.

Instrumentation for the control consoles in the Pilothouses and the EOS shall be as specified in Section 99 of the Technical Specification.

Failure of any instrument shall not cause the system to be inoperable (e.g., gage piping shall have root valves and thermometers shall have thermowells).

Instrument accuracy from source to readout shall be within plus or minus 2-percent ($\pm 2\%$) of the full scale range.

85.4 THERMOMETERS

Unless otherwise specified, remote reading temperature sensors shall be of the Resistance Temperature Detector (RTD) type.

All local reading temperature indicators shall be 3-inch dial, bi-metallic, thermometers installed directly into dry wells. The bi-metallic thermometers shall be of the highest quality, glycerin filled, field fillable, shock-resistant type. Dial faces shall have "BLACK" markings on a "WHITE" background and shall be calibrated in Fahrenheit (F) degrees.

NOTE: Care shall be exercised in selecting bi-metallic thermometers to ensure that vibrations normal to system operation do not damage either the needle and/or the internal mechanism.

All temperature sensors shall have separate dry well (thermowell) sockets. All dry wells shall be Type 316 stainless steel or Monel, and shall be compatible with the piping or equipment material. Prior to installation of any thermometer into a dry well, apply a heat conducting medium to the temperature sensing bulb of the thermometer (50/50 mixture of glycerin and graphite, or Vaseline).

BE ADVISED: Where the service temperatures exceed 350F degrees, it is not uncommon that the heat conducting medium may smoke when first subjected to a high temperature. This phenomena is caused by the vehicle, in the heat conducting medium, vaporizing and leaving the dry solids behind. This should not be cause for concern. The remaining dry solids will act equally well as a heat conducting medium for temperatures up to 1,200F degrees.

Indicator dials for thermometers with a range to 250F degrees or less shall have graduations at least every 2F degrees with figure intervals of not more than 20F degrees. Dials reading over 250F degrees shall have graduations at least every 5F degrees with figure intervals of not more than 50F degrees.

Dials for all thermometers shall be readily readable without the need for climbing, crawling or lifting deck plates to view.

Dial ranges shall be selected so that normal operating temperatures shall not be more than 75-percent (75%) of the scale range.

85.5 PRESSURE, VACUUM AND COMPOUND GAGES

Cases for gages shall be brass, aluminum, or molded phenolic, 4½-inch diameter unless it can be demonstrated that this size is impractical for the location.

Gages in the EOS shall be flush-mounted. Gages on local boards may be surface mounted.

Dial faces shall have “BLACK” markings on dull aluminum, dulled “SILVER”, or soft “WHITE” background, with graduations covering an arc of not less than 270 degrees and shall be calibrated in standard English units.

Pointers shall be shaped to permit reading to an accuracy of at least the smallest division of the scale on the instrument.

Each gage shall have a “RED” pointer to be set at the normal, maximum, or minimum operating pressure as may be required for the safe operation of the system(s) being monitored.

Unless otherwise listed and/or specified elsewhere in the Technical Specification, the graduation of the dials shall be in accordance with the requirements as listed in **TABLE 85-1**.

TABLE 85-1
Typical Pressure Gage Dial Graduation

	SCALE		SCALE DIVISION	
Gage Service	Vacuum (in. Hg)	Pressure (psi)	Vacuum (in. Hg)	Pressure (psi)
Vacuum	30	0	0.2	--
Compound	30	30	1	0.5
Compound	30	60	1	1
Compound	30	100	2	1
Compound	30	150	5	2
Pressure	--	30	--	1
Pressure	--	60	--	1
Pressure	--	100	--	1
Pressure	--	200	--	2
Pressure	--	300	--	2
Pressure	--	400 - 600	--	5
Pressure	--	800 - 1500	--	10
Pressure	--	2000 - 3000	--	20
Pressure	--	4000 - 5000	--	50

- 1 Select each gage's scale so that the normal operating pressure indication will be in the
- 2 middle one-third ($\frac{1}{3}$) of the scale range and so that the maximum system pressure does not
- 3 exceed the scale range.
- 4 Each pressure gage shall have a gage valve with test connection, connected to the gage. The
- 5 connection of the gage line to the pipe or machine shall have a second (root) valve.
- 6 Gage piping shall be in accordance with ASTM F721. Support shall be provided in
- 7 accordance with ASTM F707 / F707M.

Vibration isolation shall be provided for all gages that are mounted directly on equipment and/or machinery. All such gages shall be glycerin filled, field fill-able, **and** have “snubbers” or throttling devices installed to minimize needle vibrations.

85.6 INCLINOMETERS

Inclinometers are described in Section 15 of the Technical Specification.

85.7 ELECTRONIC INSTRUMENTS

Electronic instrument displays shall be analog or digital, as required or specified. The standard display normally supplied with specified manufacturer’s equipment shall be acceptable, unless specified otherwise. Analog displays shall be dial or bar graph type. Digital displays shall be LED or electroluminescent type, with clearly formed letters. Back-lighted LCD displays will be considered **only** if the LED or electroluminescent types are unavailable from a recognized supplier.

Analog displays shall be employed where the parameter monitored varies or oscillates rapidly, and where similar information is displayed on several instruments for ease of comparison. Analog displays shall be selected over digital displays when available.

Indicators with transducers and signal processors shall maintain the same level of accuracy required for mechanical instruments.

Instruments shall be arranged so that they can be easily read and give “expected” readouts at a glance irrespective of ambient lighting level.

Electronic instruments may be incorporated with alarms.

Each transducer for electronic instrumentation shall have a local indicator readout.

Vibration isolation shall be provided for any transducers that are mounted directly on equipment, machinery or components. “Snubbers” shall be provided for pressure transducers that are connected to systems that are normally expected to experience rapid pressure oscillations. Pressure transducers shall be provided with root and gage valves in the same manner as pressure gages.

85.8 GAGE BOARDS

Consolidate local instrumentation to the greatest extent possible and provide gage boards designed in general agreement with ASTM F707 / F707M. Use logical arrangements of instruments based on sound human engineering so that gages can be easily read and maintained. Viewing angle for instrument and panel display faces shall be perpendicular to the operator’s line-of-sight. Gages shall be located on panels in groups of logical positions

1 for rapid and easy identification of vital and/or critical readings. ASTM F1166 shall be used
2 for human engineering guidance.

3 Where access behind a gage board is not possible, provide hinged panels with safety chains
4 and flexible gage lines to permit swinging the panel out as necessary for servicing. The
5 safety chains shall prevent the panel from falling down in an uncontrolled fashion.

6 All gage boards will be fabricated from #4 finish, non-glare stainless steel sheet and will be
7 from 11 gauge or thicker material. Fabrication and installation of all gage boards shall
8 include all sheet metal, angles, hinges, chain, fasteners and supports necessary to fabricate
9 and install any gage board on the Vessel.

10 Provide a dedicated bulkhead-mounted gage board in the EOS with the following 4½ inch
11 diameter mechanical pressure gages installed: **1).** Fire Main Pressure, **2).** Potable Water
12 System Pressure, **3).** Ship Service Air System Pressure, **4).** Hot Water Heating System
13 Pressure, **5).** Auxiliary Cooling Loop Pressure End No. 1, and **6).** Auxiliary Cooling Loop
14 Pressure End No. 2. Provide stainless steel tubing, fittings, and gage line isolation valves to
15 connect these gages to their respective systems in accordance with this Section, Section 74
16 and other system specific Sections of the Technical Specification.

17 **85.9 SPARE PARTS AND INSTRUCTION MANUALS**

18 Provide a list of recommended spare parts and special tools, for those items which are
19 Contractor furnished, together with parts lists and instruction manuals necessary to maintain
20 and service provided equipment and accessories in accordance with the requirements of
21 Sections 86 and 100 of the Technical Specification.

22 **85.10 TESTS, TRIALS AND INSPECTIONS**

23 After installation and before Dock/Sea Trials all instrumentation shall be certified for
24 accuracy.

25 Installed instrumentation shall be tested and calibrated during Quality Assurance operational
26 tests, Dock Trials and Sea Trials to demonstrate its compliance with the Technical
27 Specification as to accuracy, repeatability and the match-up between local and remote
28 readouts. See the *TEST EQUIPMENT AND INSTRUMENTS* Subsection in Section 101 of the
29 Technical Specification.

30 Tests and/or trials shall be in accordance with this Section and Section 101 of the Technical
31 Specification.

32 Inspections shall be performed as defined in this Section and in Sections 1 and 2 of the
33 Technical Specification.

85.11 PHASE II TECHNICAL PROPOSAL REQUIREMENTS

See Section 100 of the Technical Specification for requirements regarding technical documentation, and in particular the requirements related to the identification of instrumentation on drawings and in Purchase Technical Specifications.

85.12 PHASE III DETAIL DESIGN AND CONSTRUCTION REQUIREMENTS

The deliverables required by Section 100 of the Technical Specification and the Authoritative Agencies, shall be provided during the Phase III Detail Design stage of Work in accordance with the requirements of Section 100 of the Technical Specification.

See Section 100 of the Technical Specification for requirements regarding technical documentation, and in particular the requirements related to the identification of instrumentation on drawings.

(END OF SECTION)